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1 Modeling motion blur in computer-generated images
Michael Potmesil, Indranil Chakravarty
July 1983 **ACM SIGGRAPH Computer Graphics , Proceedings of the 10th annual conference on Computer graphics and interactive techniques**, Volume 17 Issue 3

Full text available: 🅿 pdf(1.03 MB)   Additional Information: full citation, abstract, references, citings, index terms

This paper describes a procedure for modeling motion blur in computer-generated images. Motion blur in photography or cinematography is caused by the motion of objects during the finite exposure time the camera shutter remains open to record the image on film. In computer graphics, the simulation of motion blur is useful both in animated sequences where the blurring tends to remove temporal aliasing effects and in static images where it portrays the illusion of speed or movement among the o ...

Keywords: Camera model, Digital optics, Image restoration, Motion blur, Point-spread function

2 Image-based motion blur for stop motion animation
Gabriel J. Brostow, Irfan Essa
August 2001 **Proceedings of the 28th annual conference on Computer graphics and interactive techniques**

Full text available: 🅿 pdf(807.21 KB)   Additional Information: full citation, abstract, references, citings, index terms

Stop motion animation is a well-established technique where still pictures of static scenes are taken and then played at film speeds to show motion. A major limitation of this method appears when fast motions are desired; most motion appears to have sharp edges and there is no visible motion blur. Appearance of motion blur is a strong perceptual cue, which is automatically present in live-action films, and synthetically generated in animated sequences. In this paper, we present an approach fo ...

Keywords: animation, computer vision, image-based rendering, motion blur, stop motion animation, temporal antialiasing, video post-processing

3 A two-and-a-half-D motion-blur algorithm
Nelson L. Max, Douglas M. Lerner
July 1985 **ACM SIGGRAPH Computer Graphics , Proceedings of the 12th annual**

conference on Computer graphics and interactive techniques, Volume 19 Issue 3

Full text available: pdf(4.15 MB)   Additional Information: full citation, abstract, references, citings, index terms

Algorithms are presented for raster and vector motion blur, which produce images and masks suitable for combination by the 21/2-D compositing process. The raster algorithm is based on a "skew, blur, unskew" scheme, using a very efficient one-dimensional blurring algorithm. The vector algorithm extends the ideas of anti-aliased scan conversion to motion blur.

Keywords: compositing, computer animation, mask, motion blur, raster, skew, vector

4 Ray tracing: graphics for the masses
Paul Rademacher
May 1997 **Crossroads**, Volume 3 Issue 4

Full text available: html(40.75 KB)   Additional Information: full citation, index terms

5 With J: Fast Fourier transforms and removing motion blur
Cliff Reiter
September 2000 **ACM SIGAPL APL Quote Quad**, Volume 31 Issue 1

Full text available: pdf(335.65 KB)   Additional Information: full citation, references, index terms

6 Colour, rendering and tone-mapping: Time dependent photon mapping
Mike Cammarano, Henrik Wann Jensen
July 2002   **Proceedings of the 13th Eurographics workshop on Rendering**

Full text available: pdf(1.26 MB)   Additional Information: full citation, abstract, references, citings

The photon map technique for global illumination does not specifically address animated scenes. In particular, prior work has not considered the problem of temporal sampling (motion blur) while using the photon map. In this paper we examine several approaches for simulating motion blur with the photon map. In particular we show that a distribution of photons in time combined with the standard photon map radiance estimate is incorrect, and we introduce a simple generalization that correctly handl ...

7 Animation: from cartoons to the user interface
Bay-Wei Chang, David Ungar
December 1993 **Proceedings of the 6th annual ACM symposium on User interface software and technology**

Full text available: pdf(1.35 MB)   Additional Information: full citation, references, citings, index terms

Keywords: Self, animation, cartoons, motion blur, user interfaces

8 Rendering: An efficient spatio-temporal architecture for animation rendering
Vlastimil Havran, Cyrille Damez, Karol Myszkowski, Hans-Peter Seidel
June 2003 **Proceedings of the 14th Eurographics workshop on Rendering**

Full text available: pdf(2.84 MB)   Additional Information: full citation, abstract, references, index terms

Producing high quality animations featuring rich object appearance and compelling lighting

effects is very time consuming using traditional frame-by-frame rendering systems. In this paper we present a rendering architecture for computing multiple frames at once by exploiting the coherence between image samples in the temporal domain. For each sample representing a given point in the scene we update its view-dependent components for each frame and add its contribution to pixels identified through ...

9 Distributed ray tracing

Robert L. Cook, Thomas Porter, Loren Carpenter

January 1984 **ACM SIGGRAPH Computer Graphics , Proceedings of the 11th annual conference on Computer graphics and interactive techniques**, Volume 18 Issue 3

Full text available: pdf(909.54 KB)   Additional Information: full citation, abstract, references, citings, index terms

Ray tracing is one of the most elegant techniques in computer graphics. Many phenomena that are difficult or impossible with other techniques are simple with ray tracing, including shadows, reflections, and refracted light. Ray directions, however, have been determined precisely, and this has limited the capabilities of ray tracing. By distributing the directions of the rays according to the analytic function they sample, ray tracing can incorporate fuzzy phenomena. This provides c ...

Keywords: Camera, Constructive solid geometry, Depth of field, Focus, Gloss, Motion blur, Penumbras, Ray tracing, Shadows, Translucency, Transparency

10 Session P15: multidimensional, motion, and information visualization: Kinetic visualization: a technique for illustrating 3D shape and structure

Eric B. Lum, Aleksander Stompel, Kwan Liu Ma

October 2002 **Proceedings of the conference on Visualization '02**

Full text available: pdf(3.48 MB)   Additional Information: full citation, abstract, references, index terms

Motion provides strong visual cues for the perception of shape and depth, as demonstrated by cognitive scientists and visual artists. This paper presents a novel visualization technique --- *kinetic visualization* --- that uses particle systems to add supplemental motion cues which can aid in the perception of shape and spatial relationships of static objects. Based on a set of rules following perceptual and physical principles, particles flowing over the surface of an object not only bring ...

Keywords: animation, particle systems, scientific visualization, visual perception, volume rendering

11 Alternate rendering pipeline: Cartoon dioramas in motion

Ramesh Raskar, Remo Ziegler, Thomas Willwacher

June 2002 **Proceedings of the 2nd international symposium on Non-photorealistic animation and rendering**

Full text available: pdf(739.52 KB)   Additional Information: full citation, abstract, references, index terms

Cartoon animations delight the audience with moving characters but they remain on a flat 2D screen. The cartoon dioramas, on the other hand, are detailed, three-dimensional and allow physical interaction but they are static. We present techniques to combine the two in some limited cases. We illuminate static physical models with projectors. The images are generated with real time three dimensional computer graphics. We describe a system to demonstrate various visual effects such as non-photoreal ...

Keywords: augmented reality, immersive environments, non-photorealistic rendering, perception, virtual reality

12 <u>Video Processing: Motion-based segmentation and contour-based classification of video objects</u>

Gerald Kühne, Stephan Richter, Markus Beier

October 2001 **Proceedings of the ninth ACM international conference on Multimedia**

Full text available: <u>pdf(1.74 MB)</u>   Additional Information: <u>full citation</u>, <u>abstract</u>, <u>references</u>, <u>citings</u>, <u>index terms</u>

The segmentation of objects in video sequences constitutes a prerequisite for numerous applications ranging from computer vision tasks to second-generation video coding.We propose an approach for segmenting video objects based on motion cues. To estimate motion we employ the 3D structure tensor, an operator that provides reliable results by integrating information from a number of consecutive video frames. We present a new hierarchical algorithm, embedding the structure tensor into a multiresolu ...

Keywords: curvature scale, motion segmentation, object classification, space, structure tensor

13 <u>The accumulation buffer: hardware support for high-quality rendering</u>

Paul Haeberli, Kurt Akeley

September 1990 **ACM SIGGRAPH Computer Graphics , Proceedings of the 17th annual conference on Computer graphics and interactive techniques**, Volume 24 Issue 4

Full text available: <u>pdf(3.46 MB)</u>   Additional Information: <u>full citation</u>, <u>abstract</u>, <u>references</u>, <u>citings</u>, <u>index terms</u>

This paper describes a system architecture that supports realtime generation of complex images, efficient generation of extremely high-quality images, and a smooth trade-off between the two.Based on the paradigm of integration, the architecture extends a state-of-the-art rendering system with an additional high-precision image buffer. This additional buffer, called the Accumulation Buffer, is used to integrate images that are rendered into the framebuffer. While originally conceived as a solutio ...

14 <u>Antialiasing of interlaced video animation</u>

John Amanatides, Don P. Mitchell

September 1990 **ACM SIGGRAPH Computer Graphics , Proceedings of the 17th annual conference on Computer graphics and interactive techniques**, Volume 24 Issue 4

Full text available: <u>pdf(7.19 MB)</u>   Additional Information: <u>full citation</u>, <u>abstract</u>, <u>references</u>, <u>citings</u>, <u>index terms</u>

The production of computer-generated video presents a number of difficulties not encountered with motion pictures. Interlaced scanning and the color subcarrier of NTSC video are responsible for special problems such as interline flicker, and chroma aliasing. As in motion pictures, temporal aliasing is also an issue. A renderer can sample and filter a moving image in an arbitrary manner and is not constrained to simply imitate the behavior of a television camera. This paper explores several diffe ...

15 <u>Providing a low latency user experience in a high latency application</u>

Brook Conner, Loring Holden

April 1997 **Proceedings of the 1997 symposium on Interactive 3D graphics**

Full text available: <u>pdf(502.61 KB)</u>   Additional Information: <u>full citation</u>, <u>references</u>, <u>citings</u>, <u>index terms</u>

16 A multiple track animator system for motion synchronization (abstract only)
D. Fortin, J. F. Lamy, D. Thalmann
January 1984 **ACM SIGGRAPH Computer Graphics**, Volume 18 Issue 1

Full text available: pdf(3.92 MB)   Additional Information: full citation, abstract

MUTAN (MUltiple Track ANimator) is an interactive system for independently animating three-dimensional graphical objects. MUTAN can synchronize different motions; it is also a good tool for synchronizing motion with sound, music, light or smell. To indicate moments in time, marks are associated with appropriate frame numbers. MUTAN enables the marks to be manipulated. An animator can also adjust one motion without modifying the others. To make this possible, MUTAN handles several tracks at a tim ...

17 Motion analysis of grammatical processes in a visual-gestural language (abstract only)
Howard Poizner, Edward S. Klima, Ursula Bellugi, Robert B. Livingston
January 1984 **ACM SIGGRAPH Computer Graphics**, Volume 18 Issue 1

Full text available: pdf(3.92 MB)   Additional Information: full citation, abstract

Movement of the hands and arms through space is an essential element both in the lexical structure of American Sign Language (ASL), and, most strikingly, in the grammatical structure of ASL: it is in patterned changes of the movement of signs that many grammatical attributes are represented. These grammatical attributes occur as an isolable superimposed layer of structure, as demonstrated by the accurate identification by deaf signers of these attributes presented only as dynamic point-light dis ...

18 Selective attention to aspects of motion configurations: common vs. relative motion (abstract only)
James R. Pomerantz, Nelson Toth
January 1984 **ACM SIGGRAPH Computer Graphics**, Volume 18 Issue 1

Full text available: pdf(3.92 MB)   Additional Information: full citation, abstract

The motion of a dot configuration may be described as the sum of its relative (part) and common (whole) motion components. Is either of these two component dimensions extracted before the other in human perception? Reaction time data from selective attention experiments show that neither dimension can be responded to without interference from the other, implying that neither is processed more quickly than or ahead of the other. Following Garner's nomenclature, common and relative motions appear ...

19 The cross-ratio and the perception of motion and structure (abstract only)
William A. Simpson
January 1984 **ACM SIGGRAPH Computer Graphics**, Volume 18 Issue 1

Full text available: pdf(3.92 MB)   Additional Information: full citation, abstract

Followers of J. J. Gibson have proposed that the cross-ratio, a projective invariant for four collinear points, underlies the perception of objects in motion. Experiment 1 tested this theory by presenting subjects with displays of 3 or 4 dots rotating in depth. Accuracy was equally high in both conditions for motion and structure judgements, so the cross-ratio cannot be necessary. Experiments 2 and 3 tested the cue of lining up, and some evidence for its use was found. The results are consistent ...

20 A hybrid approach to structure-from-motion (abstract only)
Aaron Bobick
January 1984 **ACM SIGGRAPH Computer Graphics**, Volume 18 Issue 1

Full text available: pdf(3.92 MB)   Additional Information: full citation, abstract

A method is presented for computing structure from the motion of rigid objects which are rotating about a fixed axis. The input consists of two discrete frames containing the

positions and instantaneous direction vectors of three points in orthographic projection. Because only the direction of the velocity vectors and not their magnitudes is needed, the method is insensitive to errors in velocity magnitude estimation. This type of computation could be important in recovering the 3-dimensional st ...

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↑ **ABSTRACT**

This paper describes a procedure for modeling motion blur in computer-generated images. Motion blur in photography or cinematography is caused by the motion of objects during the finite exposure time the camera shutter remains open to record the image on film. In computer graphics, the simulation of motion blur is useful both in animated sequences where the blurring tends to remove temporal aliasing effects and in static images where it portrays the illusion of speed or movement among the objects in the scene. The camera model developed for simulating motion blur is described in terms of a generalized image-formation equation. This equation describes the relationship between the object and corresponding image points in terms of the optical system-transfer function. The use of the optical system-transfer function simplifies the description of time-dependent variations of object motion that may occur during the exposure time of a camera. This approach allows us to characterize the motion of objects by a set of system-transfer functions which are derived from the path and velocity of objects in the scene and the exposure time of a camera.

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↑ INDEX TERMS

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↳ I.4.8 Scene Analysis
↳ Subjects: Photometry; Motion

General Terms:
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Keywords:
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	James C. Browne	John Werth
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motion blur

Motion blur is a graphics filter used in programs such as Adobe Photoshop, Jasc Paint Shop Pro, and Corel PHOTO-PAINT to create the illusion of movement or motion. Motion blur filters smooth image transitions by averaging the pixels beside the hard edges of defined lines and shaded areas where considerable color transitions occur. The motion can be controlled by angle or direction (0 to 360 degrees or −90 to +90) and/or by distance or intensity in pixels (0 to 999), based on the software. Some programs also offer the option to ignore pixels outside the primary image, use the paper or background color as well, or sample the nearest edge pixel. These are useful options if you want to motion blur the background and the image (similar to a photo shot from a moving car) or just motion blur an object inside the image (such as a spinning top on a still background).

In animation programs, motion blur is actual movement, not the illusion. Animators can select the effect length or time and the number of frames per second (fps) for the effect to occur. For example, 10 seconds of animation at 16fps to view a spinning top or a bouncing ball. The blur angle can be from −180 to +180 degrees and the blur radius can be adjusted from 0 to 100, again based on the software. More expensive programs offer greater radius options plus additional features, such as animating the entire frame or selected objects inside the frame plus background color and fill selections.

In addition to motion blur, graphic programs also offer **Gaussian blur** (which blends a specific number of pixels incrementally following a bell-shaped curve where the blurring is dense in the center and feathers at the edges), **smart blur** (blurs rough edges inside an object), **radial blur** (blurs in a radius of concentric circles), **smooth** (similar to a soft camera lens), **directional smooth** (a soft camera lens with the blurring in one direction), soften (same as smooth), soften more (smooth again a little more), **jaggy despeckle** (smoothes the jagged edges of a low resolution image), and several others based on the program.
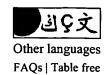
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- The 24-day **Salt March To Dandi**, a historic act of non-violent protest led by Mahatma Gandhi in colonial India, is re-enacted on its 75th anniversary.
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- 1978 - Former Prime Minister of Italy **Aldo Moro** was kidnapped in Rome by the Red Brigades.

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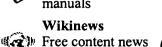
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Motion blur

From Wikipedia, the free encyclopedia.

Motion blur is the apparent streaking of rapidly moving objects in a still image or a sequence of images such as a movie or animation.

When an image of moving objects or from a moving camera is created it does not always merely represent a single instant of time. Often because of technological constraints or artistic requirements the image must represent the scene over a period of time. As objects move in a scene over time an image of that scene must represent an integration of all positions of a camera's viewpoint and object positions over the period of exposure determined by the shutter speed. Any moving object with respect to the camera in such an image will look blurred or smeared along the direction of relative motion, this smearing may occur on an object that is moving or on a static background if the camera is moving. In a film or television image this looks natural because the human eye behaves in much the same way.

Because the effect is caused by the relative motion of the camera, object and scene being imaged, the camera may be used to track moving objects by panning the camera such that even with long exposure times motion blur is avoided on the moving object but instead appears on the background.

In televised sports, where conventional cameras expose pictures 25 or 30 times per second, motion blur can be inconvenient because it obscures the exact position of a projectile or athlete in slow motion. For this reason special cameras are often used which eliminate motion blurring by taking rapid exposures on the order of 1/1000 of a second, and then transmitting them over the course of the next 1/25 or 1/30 of a second. Although this gives sharper slow motion replays it can look strange at normal speed because the eye expects to see motion blurring and does not.

Similarly, in real-time computer animation each frame shows a perfect instance in time (analogous to a camera with an infinitely fast shutter), with zero motion blur. This is why a video game with a frame rate of 25-30 frames per second will seem 'jumpy' and strange, while natural motion filmed at the same frame rate appears continuous. To compensate for this, much higher frame rates are desirable, of 60 fps or more. In pre-rendered computer animation, such as CGI movies, simply raising the frame rate is not possible, but realistic motion blur can be drawn because the renderer has much longer to draw each frame. Temporal anti-aliasing produces frames as a composite of many instants.

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